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1 Scope:

This procedure describes the methods used to manufacture the Warm-Up Heater for RHIC Helical Magnets.

2 Applicable Documents:

RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-MAG-M-7229	Electrical Resistance Measurement for Warm Up Heater Brazed Joint(s)
RHIC-MAG-R-7242	RHIC Hypot Testing
BNL Dwg.12011122	Storage Unit Warm-Up Heater Assembly

3 Requirements:

3.1 Material & Equipment

3.1.1 Material

KAPTON Tape	BNL Dwg. No. 12010181-02
KAPTON Tape	BNL Dwg. No. 12010181-05
ALCONOX	BNL Stock No. E-54150
Paper Towel	BNL Stock No. I-83312

3.1.2 Equipment

#641 Power Unit, 120 Bolt with #880 Plier Holder with 5" No. Wire

3.2 Safety:

3.2.1 Operators shall be qualified by their cognizant technical supervisor in the safe operation of the Beam Tube Wrapper.

3.2.2 Operators shall wear safety glasses with side shields, or goggles while using beam tube Wrapper or performing brazing operations.

3.2.3 Operators shall wear insulated gloves while performing brazing operations.

3.2.4 See RHIC-MAG-M-7229 AND RHIC-MAG-R-7242 for additional safety requirements.

3.3 Procedure:

3.3.1 Handling - The heater is extremely flexible, and may easily be damaged by improper handling. It must be supported to prevent bending during all assembly operations.

3.3.2 Wrapping - The heater shall be supported by free rolling supports rollers while moving through the wrapping machine.

3.3.3 Brazing Procedure

3.3.3.1 Scribe a line along the length of the 5.33" Warm-Up Heater brass tubing (P/N12011091-02) on center with the 0.062 vent hole.

3.3.3.2 Support the swaged brass tubing such that it is aligned with the main stainless steel tubing.

3.3.3.3 Apply a thin film of brazing filler metal paste (P/N 12050186) to the .63 inch swaged section of the brass tubing and slide inside the main tubing.

3.3.3.4 Heat the section to above 11450F using the brazing power unit. (A setting of 3.9 held for a minute is sufficient.) The heat shall be applied directly to the stainless steel, not the brass.

3.3.3.5 Clean any excess paste with a mild alkaline detergent (Alconox, BNL E-54150).

3.3.3.6 Repeat steps 3.3.3.2 through 3.3.3.5 for the second end.

3.3.3.7 Check the interior of the heater tubing in the area of the braze joint for any obstructions. Insert a .045 diameter SST weld rod 18 ± 1 inches into each end of the heater. If any blockage is found, drill out the obstruction using a .062 diameter extension drill (12 inches long min).

3.3.3.8 Perform electrical resistance measurement on brazed joints at 10A per RHIC-MAG-M-7729. Verify assembly passes test and sign off operation on production traveler.

3.3.4 Insulation Procedure

3.3.4.1 Inspect the heater sub-assembly for bends, kinks and general appearance.

3.3.4.2 Cleaning - Clean the heater surface with alcohol and clean cloths, until no contamination is evident on the cloth. Wipe dry.

- 3.3.4.3 Set the wrapping machine's controls to their initial settings (RHIC-OPM-8.1.1.27, paragraph 5.6).
- 3.3.4.4 A copy of drawing 12050131 should be available at the wrapping machine. Any discrepancies between the drawing and this MAP must be brought to the attention of the cognizant engineer before work begins.
- 3.3.4.5 Attach the drive chain to the heater assembly using the clamp provided.
- 3.3.4.6 Mount the heater assembly (12050130) on the rollers in the wrapping machine, with the end projecting from the wrapping head $2.6 \pm .25$ inches

CAUTION: Some of the following steps require the operator to temporarily place his hands inside a guarded area. Ensure that guards are fully opened and that machine cannot be activated while working inside the guarded area.

- 3.3.4.6.1 Using a 2 inch piece of adhesive backed tape (P/N12010181-02), secure the end of the KAPTON tape (P/N12010181-05) to the heater tube.
- 3.3.4.6.2 Set speed controls for proper pitch of tape wrap. Set the head speed (RPM) to be five times the heater tube feed rate (INCHES PER MINUTE).
- 3.3.4.6.3 Wrap one layer of KAPTON Tape (P/N1201081-05), 50% overlap, for the length specified on drawing. Secure the end of the tape with a 1 inch piece of adhesive backed tape. Maintain tape tension in the range of 5-10 lbs. during winding.
- 3.3.4.6.4 Repeat the procedure of the above wrapping step until there are a total of three layers of KAPTON tape over the length of the heater. Remove heater from machine and trim KAPTON as indicated on print.
- 3.3.4.6.5 Set the speed controls for the proper pitch for a butt wrap (butt to .06 gap) of copper foil (P/N12010074-01) over the KAPTON wrap. Attach the copper foil to the heater, located per print, using a 1 inch piece of adhesive-backed tape (P/N12010181-02), and butt wrap a single layer of copper foil (P/N12010074-01) over the KAPTON wrappings. Wrap for length specified on drawing. Maintain a tension of 3-5 lbs. during wrapping. Secure the trailing end with adhesive-backed tape (P/N12010181-02). Do not trim foil using tubing cutter.
- 3.3.4.6.6 Inspect the heater to be certain that the copper foil tape is secure at the leading and trailing corners of the tape.

- 3.3.4.7 Slide the two $4.05 \pm .1$ inch lengths of shrink tubing (P/N12040126-02) $.25 \pm .06$ inches over the copper foil on the non-retainer end. Shrink the tubing by blowing heated air ($>2750\text{F}$) uniformly over the surface. Slide the two $1.45 \pm .1$ inch lengths of shrink tubing (P/N12040126-02) over the copper wrap at the other end, position tubing according to print, and shrink using heated air as before.
- 3.3.4.8 Reopen the vent hole on the tubing on the non-retainer side of heater. Measure in 0.8 along the center scribe line on tubing and puncture the insulation through to the vent hole.
- 3.3.5 Install the heater retainer (P/N12050112) so the far side of clip is 0.6" in from the end of the tubing (P/N12011091-01). Crimp retainer in place.
- 3.3.6 Perform Hypot test per RHIC-MAG-R-7242. Test the heater assembly at 2.5kV for 30 seconds between the heater tube and the copper foil (ground). Maximum leakage current is 50 A. Verify assembly passes test and sign off operation.
- 3.3.7 Slide a batch of tested heaters into protective sleeve, along with traveler. Pack to prevent damage and forward to stock.
- 4 Quality Assurance Provisions:
- 4.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.
- 4.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.
- 5 Preparation for Delivery:
- N/A